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Budget Deficit and Interest Rates: Is there a Link ?

International Evidence

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1. Introduction

An issue giving rise to recurrent debate in macroeconomics concerns the dynamic impact of fiscal policy. Recently, the question has arisen as to whether the persistence of large budget deficits over the last two decades in major industrial countries is partially responsible for the high level of interest rates observed world-wide during this period. In view of its importance, the issue of the linkage between large budget deficits and high interest rates has been addressed in a large and growing number of publications.

The existence of a relationship between large budget deficits and high interest rates would have several implications. One relates to the crowding-out of private investment: high real interest rates may lead to a decline in the interest-sensitive components of private spending such as investment and, consequently, may lead to a decrease in capital accumulation. Thus high real interest rates induced by large budget deficits have a negative impact on potential growth, shifting the economy to a low level growth path and may therefore reduce future living standards.

Another implication refers to the setting of the economic policy-mix. If such a relationship was verified, the fixing of fiscal policy could be more supportive of monetary policy. A reduction of budget imbalances could moderate upward pressures on interest rates and could therefore shift the burden out of monetary policy allowing for additional degrees of freedom in interest-rate management. In a large number of industrial countries, actual fiscal imbalances prevent monetary policy from properly managing interest rates. Thus, in order to stimulate economic activity, the setting of both monetary and fiscal policies needs to be reassessed within a comprehensive framework of sound and stable fiscal balances over the medium term[1].

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[1] In fact high structural budget deficits do not allow for automatic/discretionary stabilisation, thereby shifting adjustment to monetary policy.

It is also important to examine the linkages between large deficits and high interest rates in the context of the growing integration of world capital markets. The globalization of world financial markets now means that deficits may be financed by external borrowing. As a result, the impact of budget deficits can be spread throughout the world and upward pressures on national interest rates can thus be moderated. In that case, co-ordination of national fiscal policies becomes a key issue, in order to prevent upward pressure on world interest rates resulting from global capital demand.

In this paper, we investigate the existence of the relationship between nominal and real long-term interest rates and budget deficits. Long-term interest rates have been preferred because they are a key determinant of capital accumulation and play a central role in the transmission of macroeconomic policies to the economy. Like most policy debates, almost all the empirical research in this topic has focused on the United States. We have extended our analysis to nine other countries and to the world level, which can be useful for several reasons[2]. First, international evidence about the link between budget deficits and interest rates can provide more information on the robustness of the empirical results. Second, in the light of growing integration of world capital markets, it is also useful to test this relationship in the case of small open economies. Third, it is important to test this link at a world level so as to highlight the need for policy coordination in order to prevent a rise in global capital demand resulting from budget deficits world-wide.

The paper is structured as follows. The theoretical considerations are discussed in section 2. Section 3 offers an analysis of historical trends in long-term interest rates and budget deficits. Section 4 presents the model while more specific issues on econometric methodology and the treatment of expectations are dealt with

[2]We have carried out our analysis for the following countries: United States, Japan, Germany, France, United Kingdom, Canada, Belgium, Denmark, Ireland and Netherlands.

in section 5. The empirical evidence is presented in section 6 and main conclusions follow in section 7.

2. Theoretical considerations

An extensive debate has developed around the issue of the linkages between large budget deficits and high interest rates. Many authors have tested empirically this relationship and have found contradictory results. On the one hand, Mascaro and Meltzer (1983), Makin (1983), Hoelscher (1983), Plosser (1982,1987) and Evans (1985,1987) find no significant connection between budget deficits and interest rates while, on the other hand, Hutchinson and Pyle (1984), Tanzi (1985), Tanzi and Lutz (1991), Hoelscher (1986), Cebula and alii (1988) and Spiro (1990) put forward results confirming the existence of such a relationship.

The approaches adopted in these papers are different from each other but some common characteristics can be identified. We noticed that studies that reject the existence of such a link have two main features: first, they test short-term interest rates and, second, they use quarterly or even monthly data in the regressions. Some of them (Plosser 1982 and 1987) use anticipated deficit and public debt variables, instead of the actual deficit as an explanatory variable, with the same negative results. On the contrary, those who find a positive relationship generally test the impact on long-term interest rates and use annual data.

It seems to us that, from a theoretical point of view, long-term interest rates are to be preferred in empirical work. In fact, if budget deficits matter for the economy in general and for the level of interest rates in particular, it must be on an inter temporal decisions basis of economic agents. In a growth economy with capital accumulation, increasing budget deficits may create over the long-term a shortage of funds available for investment. If this potential imbalance between the supply of funds and

intended investment is not met, long-term interest rates react as economic agents anticipate the shortage of funds. The main channel through which this operates is the term structure of interest rates. According to a simple model presented by Blanchard and Fischer (1989, page 134), the effect of present budget deficit on short-term rates "is initially small, but because debt levels are anticipated to increase (due to the additional deficit) the effect is larger on anticipated future short-term rates. Thus, ..., long-term rates increase (now) in anticipation of high short-term rates later". Turnovsky (1989) reaches a similar result within a complete macroeconomic model, under the assumption that agents hold rational expectations. In his model, the behavior of the term structure depends on whether fiscal policies are permanent or temporary and anticipated or unanticipated. When fiscal policy is unanticipated, the most significant result is that a permanent fiscal expansion has a greater effect on expected future short-term rates than on the present short-term rate, thereby causing via the term structure a greater increase in the current long-term rate. An anticipated permanent fiscal expansion raises both long-term and short-term rates by the same amount.

The very fact that the interest rate term-structure is explicitly integrated in the estimated equation seems to us very important because we can allow for other significant determinants of long-term rates such as monetary policy and anticipated inflation. As far as we know, only two studies take into account the term structure (Hoelscher (1986) and Cebula and alii (1988)) and both provide significant supportive results.

Concerning data periodicity, annual data appear preferable for two reasons. First, annual data are less likely to be distorted by transitory shocks that affect interest rates and therefore put more emphasis on the fundamental factors. Second, the budget deficit is an overall annual concept because the timing between actual government expenditure and receipts or deficit financing may not closely correspond in shorter periods.

Besides the above considerations that may explain the lack of relationship between interest rates and budget deficits in empirical work, some authors have put forward the existence of a "Ricardian equivalence " phenomenon in order to explain this absence of relationship. Others have put emphasis on the integration of world capital markets.

The loanable funds model offers a sufficiently large framework for the analysis of long-term interest rates behaviour, taking into account the above theoretical considerations, as it allows the combination of the characteristics of the term-structure with policy variables such as the government deficit. In this framework, long-term interest rates are determined by demand and supply of funds. Other things being equal, if the demand for funds increases following a budget deficit, interest rates must rise as the demand schedule shifts upwards. Still, a higher interest rate need not follow if the global equilibrium effect of an increase in the government deficit is met by a downward shift in the supply curve or if the supply curve is infinitely elastic.

The former case can be explained by the so-called "Ricardian equivalence" theorem (Barro 1974). According to this theorem, if consumers anticipate the future implications of current government deficits, they would realise that the public debt being created now by government borrowing must be repaid in the future by an increase in taxes. In order to smooth their consumption over time and therefore to avoid a sharp decline in their future disposable income to pay the extra future taxes, rational economic agents will increase their savings now. To the extent that these savings increases offset the rising deficit, interest rates are less or not at all affected.

The literature on this subject is highly controversial. Barro (1989, p.48), for example, suggests that "overall, the empirical results on interest rates support the Ricardian view. Given these findings it is remarkable that most macro economists remain confident that budget deficits raise interest rates". Furthermore, Evans (1985

and 1987) finds in Kormendi (1983) strong support in favour of the Ricardian equivalence theorem in order to explain the lack of relationship between interest rates and budget deficits.

In opposition to that, Gramlich (1989) has graphically demonstrated that "national saving seems to have clearly declined in response to large federal deficits" in the U.S. during the eighties. Leiderman and Blejer (1988) point out that Ricardian equivalence requires restrictive assumptions about the economic environment and the behaviour of economic agents which are very difficult to observe in the real world. They referred to four main conditions that actually explain deviations from Ricardian equivalence: the existence of borrowing constraints, distortionary taxes, uncertainty about future taxes and different planning horizons for private and public sectors. Finally, G. Nicoletti (1989) tested in a cross-country analysis the Ricardian hypothesis with overall negative results.

It is clear that the Ricardian theorem is a sufficient but not necessary condition to explain the absence of relationship between deficits and interest rates. On the contrary, if this relationship is empirically observed, one can reject the Ricardian hypothesis.

The second case where interest rates are less affected by budget deficits is when the supply of funds curve is infinitely elastic. This hypothesis is plausible when we take into account the integration of world capital markets through which national budget deficits can be financed, partly or wholly, at the current world long-term rate. In this context, the size of the domestic economy is a determining factor: in a small country with open capital markets, an increase in the public borrowing requirement should not affect national interest rates as far as this is financed by a net capital inflow from abroad. Thus, the financing of the borrowing requirement is not limited by the size of domestic savings. The relationship between national saving and national borrowing requirements is linked to the controversy initiated by Feldstein and

Horioka (1980) who showed that, for the period 1960-1974, there was a strong link between domestic savings and investment.

Recent studies (Dean, Durand, Fallon, and Hoeller, OECD 1990) have shown that the relationship between national savings and national borrowing requirements has faded out during the eighties which confirms that, during this period, capital markets have been increasingly integrated. Despite these findings, domestic supply of funds remains an important determinant of domestic borrowing requirements. Thus, an increase in the budget deficit will put upward pressure on domestic interest rates even if part of the gap between national saving and national borrowing requirements is financed by foreign capital inflows.

3. Trends in long-term interest rates and budget deficits (1970-1990)

The behaviour of real and nominal long-term interest rates over the past two decades in the major industrial countries seems to have been influenced by similar factors. After the first oil-shock of 1973-1974, many industrial countries have experienced negative or very low real long-term interest rates as increases in inflation were larger than increases in nominal long-term interest rates (see chart 1)[3]. The two main factors behind the negative correlation between real long-term interest rates and inflation in mid-1970s were the surprisingly sharp acceleration of inflation following the oil-shock and the financial regulations in most countries which prevented inflation from being fully reflected in nominal long-term interest rates.

The steep rise of both nominal and real long-term interest rates at the end of the seventies coincided with a large number of events.

First, following the acceleration of inflation after the two oil-shocks of 1973-1974 and 1979 (see chart 2), inflationary expectations have been more rapidly adjusted and fully reflected in nominal interest rates. This, coupled with the deregulation of financial markets, has resulted in a rapid increase of both nominal and real long-term interest rates.

Second, monetary authorities were more concerned about the acceleration of inflation at the end of the seventies. The disinflationary stance pursued by the central banks pushed nominal short-term interest rates to historically high levels. Long-term interest rates have been in turn affected via the term structure (see chart 3).

Third, after the first oil-shock of 1973-1974 budget deficits became unusually large and persistent in the major industrial countries as a result of both the slowdown in economic growth and the expansionary fiscal stance to support the level of

[3]This conclusion seems to be true irrespective of the measure of anticipated inflation used to generate series of ex-ante real interest rates.

economic activity (see chart 4). The emergence of large budget deficits put heavy strain on the capital markets to finance them because budget deficits have become world-wide an important drain on the supply of funds. Given the imbalances between the supply and demand of funds, higher long-term interest rates were under pressure in order to clear capital markets.

In the course of the 1980s, lower inflation rates and easing monetary conditions resulted in a decline in nominal and real long-term interest rates from their peaks of the early 1980s (chart 1), although the latter have remained higher than during the previous two decades particularly in the European countries. Actually, in all countries considered here but the United States, real long-term interest rates have stayed on a smoothly upward slope or in a high steady-state pace, after a moderate decline in the early 1980s. In the United States, real long-term interest rates increased rapidly and particularly steeply in the early 1980s, but this was followed by a decline after 1984 reaching a somewhat lower level than in some other industrial countries, by the end of the decade.

It seems that the divergence in the behaviour of real long-term interest rates between the United States and other major industrial countries after 1984 has stemmed in large part from the important size of the U.S. budget deficits relative to both national and world savings. In fact, after the sharper increase in the United States real long-term interest rates at the beginning of the 1980s, capital flew in from abroad, as the United States was running large budget deficits[4]. As funds went to the United States, the "crowding-out" effect of the U.S. budget deficits was spreading throughout the world. This effect mitigated the upward pressures on real long-term interest rates in the United States while in the other countries the outflow of funds created upward pressure on their real long-term interest rates.

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[4] There is a widespread agreement that the large budget deficits that emerged in the 1980s in the United States have partially spilled over on to the current account. See Paul Krugman (1987) , Helliwell (1989), and authors cited in Warren Tease and alli (1991).

In the late 1980s, as inflation rates have risen again in most industrial countries, monetary conditions have become tighter particularly in Europe and budget deficits have increased significantly, nominal and real long-term interest rates have been rising world-wide.

All these factors suggest that the link between budget deficits and long-term interest rates must be assessed within a framework which takes into account the main determinants of long-term interest rates, i.e. anticipated inflation, the term structure, macroeconomic policies and the world capital linkages. The loanable funds model offers a sufficiently large and flexible framework to carry out this analysis.

4. The model

The model is based on the loanable funds equilibrium approach, according to which the long-term interest rate is determined by the demand and supply of funds in the economy. Similar models have been used by G. Hoelscher (1986) and Cebula and alii (1988). In equilibrium, supply and demand of funds are equal:

$$S(i_L \; r_S \; \pi^e \; d) - D(i_L \; r_S \; \pi^e \; d \; g) = 0 \qquad (1)$$

The supply schedule of long-term funds S( ) depends positively on i_L, the long-term nominal interest rate; negatively on the short-term real interest rate r_S ; as r_S increases investors have incentives to reduce holdings of long-term assets and to shift their funds to the short-term segment of the loanable markets; and negatively on the expected inflation rate π^e ; as π^e increases, the expected real return $(i_L - \pi^e)$ on long-term assets declines and S( ) falls. In addition, according to the "Ricardian equivalence" , the supply schedule is an increasing function of the budget deficit d [5].

The demand schedule of long-term funds, D( ), depends negatively on the nominal cost of borrowing i_L, and positively on the expected inflation rate π^e, because as π^e rises, long-term borrowing becomes cheaper in real terms. On the other hand, the demand schedule is positively related to the short-term real interest rate r_S, because borrowing long-term funds is relatively more attractive than short-term funds whenever r_S rises. The demand schedule is an increasing function of the budget deficit d, which accounts for the increase of government bonds in the loanable markets. Finally, the term g is the annual growth of real GDP. This variable is proxying for the accelerator effects of the business cycle on investment and on consumption of durable goods.

The equilibrium condition can be solved for the long-term nominal interest rate as a function of the other variables. Solving for i_L and linearizing, yields:

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[5] See Tanner (1970) for a model where budget deficits enter directly in estimated savings functions.

$$i_L = \alpha_0 + \alpha_1 r_s + \alpha_2 \pi^e + \alpha_3 d + \alpha_4 g + u \qquad (2)$$

where u is structural disturbance affecting long-term rates.

Although we have not developed a complete structural model, our approach is consistent with both IS-LM and the term-structure models.

The nominal long-term interest rate and the expected inflation rate are entered separately in equation (2) to account for some departure from the full Fisher effect, which predicts a unity coefficient on π^e.

In fact, most empirical studies have found that anticipated inflation impacts on nominal interest rates with a coefficient less than unity (see Mishkin 1984). Fried and Howitt (1983) presented a model in which the ability of bonds as well as money to reduce transaction costs helps to account for the failure of the full Fisher effect. Recently, Mishkin (1991) found that interest rates and inflation are cointegrated variables when they exhibit trends, but in the periods in which "either inflation and interest rates do not display trends, there is no long-run Fisher effect to produce a strong correlation between interest rates and inflation". The Fisher effect's lack of robustness raises an important issue on the empirical investigation of the relationship between interest rates and budget deficits. If in équation (2) we impose a unity coefficient on the anticipated inflation, i.e. $\alpha_2 = 1$, we are testing a joint hypothesis of the full Fisher effect and of the link between long-term interest rates and budget deficits. Thus, the predicted failure of the full Fisher effect may bias all results if the imposed value of the coefficient is not verified.

The equation (2) can be used to test the hypothesis that high long-term nominal interest rates are positively associated with high budget deficits, after controlling for other systematic influences on long-term rates, i.e. monetary policy, expected inflation and the business cycle phase. According to the above

explanation, the coefficients on these variables, α_1, α_2, and α_4, are expected to be positive.

On the other hand, the parameter α_3 on the budget deficit, which is the parameter of interest in our analysis, has an ambiguous sign. In fact, according to the model, when the deficit grows (deficit is a positive number) the supply of government bonds increases and, consequently, the demand schedule for long-term funds shifts upwards, resulting in a higher long-term nominal interest rate, other things being equal. Nonetheless, a higher nominal interest rate is not a necessary result if the deficit enters in the supply of funds, in which case the global equilibrium effect of an increase in government deficit is an increase in the supply of funds by a downward shift of the supply curve, i.e. Ricardian equivalence holds. An increase in the supply of funds by a movement along the supply curve could also be reached without affecting long-term interest rates if the supply schedule S is infinitely elastic with respect to the long-term rate , i.e. through integrated world capital markets. Thus, the extent to which an increase in government deficit affects long-term interest rates depends on both the interaction between deficit and private saving and through international linkages.

It is worth noting that our model is compatible with the growing integration of world capital markets. This is because the term structure, which plays a key role in our model, sets up an intertemporal relationship between long-term and short-term interest rates. To the extent that world capital markets are integrated, the term structure should reflect prevailing long-term interest rates determined by world capital markets, otherwise the solution for the long-term interest rates obtained by the term structure and the world capital markets would be incompatible.

5. Expected inflation and econometric issues

5.1 Expected inflation

An important issue of the above developed model is that the relationship between nominal interest rates and expected inflation is specified with respect to expectations about future inflation rates rather than in terms of expectations formed in the past about current inflation. In fact, the dating scheme assumed in equation (2) requires that expectations are conditioned on an information-set of all relevant and currently realised variables, including actual budget deficits. Equation (2) is rewritten in order to explicitly show the dating scheme:

$$i_{Lt} = \alpha_0 + \alpha_1 r_{St} + \alpha_2 \pi^{e}_{t+j} + \alpha_3 d_t + \alpha_4 g_t + u_t \qquad (2')$$

Some theoretical difficulties and econometric problems arise in this kind of model and which may bias parameters' estimates towards a false relation between deficits and long-term interest rates.

A common criticism of the statistical methodologies employed is that it is difficult to construct appropriate proxies for market expectations of future inflation rates, since they are not directly observable. As the information-set includes also currently realised variables, one of the variables in the equation, such as deficits, may to a certain extent proxy for expected inflation if this variable is not correctly measured. This is a central point, because the impact of government deficits on nominal interest rates may operate through an increase in expected inflation leaving the long-term real interest rate unchanged, thus deficits producing no crowding-out effects .

Different statistical methodologies have been employed in the literature to construct appropriate proxies for the market's expectations of future inflation. Evans (1985,1987) related the expected inflation rate to other economic variables such as government spending, the deficit and the real money stock. Others (Plosser

1982,1987; Barro and Martin 1990) have generated series of expected inflation using auto regressive models. Another alternative is to use surveys of inflationary expectations such as the Livingston index, as Tanzi (1985) and Hoelscher (1986) did.

More recently, W. Tease and al. (OECD 1991) used the low frequency component of consumer price changes as generated by the Hodrick-Prescott (HP) filter (see Hodrick and Prescott 1980, King and Rebelo 1992) to model the expected inflation. This filter is also used in this paper for the same purpose.

In order to clarify our choice, let us consider the problem that the econometrician faces to capture expected inflation from observed series. The researcher views the observed inflation π as containing both expected π^e and unexpected π^u components:

$$\pi_{t+j} = {}_t\pi^e_{t+j} + \pi^u_{t+j} \qquad (3)$$

where the subscript t denotes the current period and t+j denotes the time horizon to which interest rates refer. Therefore, observed inflation in period t+j is equal to the anticipated inflation formed at previous period t for period t+j, plus an unexpected random component.

At period t+j, the econometrician can observe π but cannot measure either π^e or π^u. However, if prices are sticky, we can develop an adjustment rule in which expected inflation moves continuously and adjusts gradually over time. So, we can extract the unobserved expected inflation by solving the following minimisation problem, which leads to the HP filter:

$$\underset{\pi^e}{Min} \sum_{t=1}^{T} (\pi - \pi^e)^2 + \lambda * \sum_{t=2}^{T} \left[(\pi^e_{t+1} - \pi^e_t) - (\pi^e_t - \pi^e_{t-1}) \right]^2 \qquad (4)$$

Our objective is then to select the expected inflation π^e which minimises the sum of the square deviations from the observed inflation π, subject to the constraint

(3)

that changes in the expected inflation vary gradually over time. The Lagrange multiplier λ is a positive number that penalises changes in the expected inflation. The larger the value of λ , the smoother is the resulting expected inflation. The choice of the value of λ coefficient depends on the degree of the assumed price stickiness.

For the minimisation problem, the first-order condition takes the form of the fourth-order difference equation:

$$0 = -2(\pi_t - \pi_t^e) + 2\lambda * \left[(\pi_t^e - \pi_{t-1}^e) - (\pi_{t-1}^e - \pi_{t-2}^e)\right]$$

$$-4\lambda * \left[(\pi_{t+1}^e - \pi_t^e) - (\pi_t^e - \pi_{t-1}^e)\right]$$

$$+2\lambda * \left[(\pi_{t+2}^e - \pi_{t+1}^e) - (\pi_{t+1}^e - \pi_t^e)\right] \qquad (5)$$

By manipulating this difference equation (see King and Rebelo for details), we can develop a time domain representation of the filter in which expected inflation π^e is represented by a two-sided moving average expression of the observed inflation:

$$\pi^e = \sum_{j=-\infty}^{\infty} \alpha_{|j|} \pi_{t+j} \qquad (6)$$

where the parameters α depend on the value of the Lagrange multiplier.

It is important to stress that the HP filter has good mathematical properties in order to extract the unobservable variable of expected inflation out of the observed series. The expected inflation series computed using the HP filter contains both forward- and backward-looking information on inflation rates, which makes it a relevant candidate to work within a rational expectations framework with sticky prices and slow adjustment. Past information is necessary to adjust prices from a disequilibrium position, while information regarding future trends is also required

because rational economic agents look forward in time to form expectations about the future inflation rate[6].

5.2 Econometric issues

The choice of the econometric method to be used in order to estimate equation (2) is also crucial because we are faced with several phenomena that need to be properly addressed:

1. As presently expected future inflation is an unobservable variable, we cannot rule out completely the possibility of measurement errors.

2. All variables - both dependent and explanatory - are jointly and simultaneously determined by the system. Simultaneous determination refers mainly to two couples of variables: first, short-term and long-term interest rates (term-structure) and, second, the deficit and long-term interest rate.

3. Past long-term interest rates influence present and future deficits through interest payments on debt formed in previous periods.

We can therefore identify a number of econometric problems which result from these issues:

First, points 1 and 2 imply that there is a correlation between errors at time t and explanatory variables during the same period: $E(x_t, u_t) \neq 0$.

Second, point 3 implies a correlation between current budget deficit and lagged errors: $E(x_t, u_{t-l}) \neq 0$.

Finally, point 1 also implies error auto correlation[7] : $E(u_t, u_{t-1}) \neq 0$.

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[6] See Mussa, M (1981) for a similar result of an adjustment price rule that combines rational expectations with sticky prices and slow adjustment.

[7] On this kind of problem, see R. Cumby and alii (1983, p.337)

All these econometric issues do not seem to have been addressed by the majority of the relevant published empirical studies. In the absence of correction for auto correlation of errors and simultaneity between variables, traditional econometric methods will be inefficient and inconsistent. For exemple, if we take point 3, the parameter estimate of budget deficit will be biased towards 0. In the case of a small sample, the bias is: $E(\hat{\beta}_1 - \beta) = -2(\beta_1 / T)$. See Th. Fomby and alii, 1984, p. 239.

As Cumby and alii (1983) have shown, even generalised two-stage least squares (G2SLS), produce inconsistent parameter estimates if the covariance matrix of the errors is not conditionally homoscedastic with respect to the instruments. This is because regressors and instruments are correlated with past residuals.

In order to address these econometric problems, we have employed the two-step two-stage least squares (2S2SLS) procedure (as proposed by R. Cumby and alii (1983)) for the estimation of our model. This is an efficient and consistent procedure in order to correct for these shortcomings. First, instrumental variables (two-stage least squares) allow to correct for simultaneity and, second, the two-step estimation allows for correction of residuals' auto correlation.

Let Q_t be the matrix of explanatory variables in equation (2), y the nominal long-term interest rate, X_t be the matrix of instrumental variables, β the vector of parameters and U_t the vector of residuals. Equation (2) is rewritten in matrix form:

$$y = Q\beta + u \qquad (7)$$

Premultiply (7) by the transposed instrumental matrix to obtain:

$$X'y = X'Q\beta + X'u \qquad (8)$$

The 2S2SLS parameter estimate in (8) is:

$$\beta = (Q'X\hat{\Omega}^{-1}X'Q)^{-1}Q'X\hat{\Omega}^{-1}X'y \qquad (9)$$

where $\hat{\Omega}$ is a consistent estimator of the covariance matrix of the errors conditionally on the matrix of instrumental variables. Obtaining this matrix is the first step of the two-step estimation procedure. In the first step, we have estimated the vector of residuals by estimating equation (2) using ordinary least squares. Then we have constructed the covariance matrix of residuals under the condition of the matrix of instrumental variables, using the Hansen (1982) procedure. The estimator is equal to the spectral density matrix evaluated at frequency zero of:

$$\hat{\Omega} = \sum_{k=-L}^{L} \sum_{t=1}^{T} u_t X_t' X_{t-k} u_{t-k} \qquad (10)$$

Then, in the second step, we have estimated the same equation with instrumental variables (two-stage procedure) weighted by the above covariance matrix to obtain the parameter vector in (9).

6. Empirical evidence

Equation (2) has been estimated using the 2S2SLS procedure, with annual data for 10 OECD countries during the period from 1970 to 1990. Deficits are measured as a percent of GDP and they correspond to the general government net borrowing requirement. Nominal short-term and long-term interest rates are respectively money market rates and yields on long-term government bonds. Inflation rate is measured by consumer price index (CPI).

The instrumental variables used here are lagged "world" short-term interest rates, lagged "world" long-term interest rates, lagged "world" budget deficits, time trend and square time trend. It is worth noting that the instruments used in all equations are the same, namely variables referring to the "world" (see below). Using common "world" instruments allowed us to take into account integration of world capital markets in an homogenous manner. It also allowed us to ensure that the term

(4)

structure , which is reflected in every country-model, is compatible with the integration of capital markets.

Regression results are reported in table 1. The results show that regression estimations for *all* countries without exception fit the data very well. R^2 values obtained show that the equations fitted explain around 90% of the long-term rate variation in all countries. D.W. statistics show the absence of residual auto correlation problems in all countries, although Germany has a lower statistic (1.10).

Coefficient estimates for *all* variables and *all* countries are without exception statistically significant with the theoretically predicted signs. T-statistics are in all cases strongly significant. We can therefore conclude that, given the statistical significance of all statistics, the data strongly support our model which appears to be well specified.

Although the coefficients on expected inflation are strongly significant, some departure from the Fisher effect can be observed except in the case of the United-States, France, Canada and the Netherlands, where the estimated coefficients are very close to one. These results confirm the importance of our choice not to impose a unity coefficient on the anticipated inflation variable, otherwise results would have been biased.

The estimated relation between short-term and long-term interest rates is significantly positive and shows the importance of having taken into account the interest rate term-structure in our model. This way we can control for factors that affect long-term interest rates through the term-structure, as monetary policy does. According to our estimated coefficients, one percentage point increase in the real short-term interest rate raises the nominal long-term one by 30 to 96 basis points.

We have also introduced annual real GDP growth to take into account the accelerator effect on investment. This effect is significant only in the case of the US. and Japan, the two biggest countries of our sample[8].

After having controlled for other systematic factors affecting long-term interest rates, our results show a very strong and significant influence of budget deficits on both real and nominal long-term interest rates in all countries without exception. The estimated coefficients range from 0.17 to 0.72 and can be interpreted as follows: one percentage point increase in the budget deficit to GDP ratio over a one year period raises long-term interest rates by 17 to 72 basis points.

However, the overall impact depends on the level of the budget deficit to GDP ratio. Table 2 presents the estimated impact of average deficit observed over the period from 1980 to 1990. The US, which features the highest marginal impact of our sample with 72 basis points, has an effective average impact of 182 basis points while Belgium, with 42 basis points of marginal impact, has the highest effective impact, of 379 basis points on average. These results are similar to those presented by Hoelscher (1986).

Given the above results, we must conclude that the effect of budget deficits on long-term interest rates has been strong in the recent period. Our approach including the term-structure and budget deficits allow us to incorporate explicitly the policy-mix. Thus, the policy-mix implemented in our sample countries during the early eighties, which was characterised by restrictive monetary policies and high budget deficits, largely explains the high nominal and real long-term interest rates observed during this period. Our conclusions are also corroborated by the conclusions of a recent OECD study (W. Tease and alii 1991).

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[8] In the case of some other countries, the estimation results not reported here show an even more significant negative coefficient for this variable. We did not explore this phenomenon but a possible explanation is that real GDP growth affects both the demand of funds through the accelerator effect on investment and the supply of funds through an increase in saving.

While the impact of real long-term rates on investment varies by country, these rates are nevertheless among the principal determinants of investment decisions. Our econometric evidence therefore shows that higher budget deficits would lead to crowding-out of private investment. Fiscal consolidation seems in this perspective as a decisive factor towards investment driven growth.

We have estimated equation (2) in the case of the "world" as a whole, i.e. the sum of the OECD economies. As variables for this entity are not directly observable, we have constructed the "world" variables, necessary for the estimation of the equation, by aggregation of corresponding variables of the component countries. These "world" variables are calculated as weighted averages. "World" interest rates and inflation rates are averages of corresponding rates of the five major industrial countries weighted by their share in SDR composition[9]. "World" deficit is the average of OECD countries' deficits weighted by their share in total OECD GDP. The results obtained for this equation are:

$$\underset{(5.0)}{i_L} = \underset{(32.8)}{1.18 + 0.72 * r_S} + \underset{(29.0)}{0.76 * \pi^e} + \underset{(23.7)}{0.64 * d} + \underset{(6.6)}{0.12 * g} + u_t, \qquad R^2 = 0.94, \quad D.W. = 1.88 \tag{9}$$

where t-statistics are in parentheses. Once again, we notice that the regression fits the data remarkably well. This regression result shows that, after controlling for the effect of short-term rates and expected inflation, demand for funds arising from budget deficits at the "world" level definitely raises the relative price of these funds, i.e. the "world" long-term rate.

This result is not surprising to the extent that the loanable funds framework used here considers the long-term interest rate as the result of demand and supply of funds on the capital markets, whether national or international. Moreover, it

[9]The weights used are: United States 0.42, Germany 0.19, Japan 0.15, France 0.12, and United Kingdom 0.12.

provides strong support in favour of the hypothesis of high degree of integration of world capital markets.

The regression result obtained at the "world" level combined to the results obtained at the country-by-country level shows that domestic fiscal policy plays an important role in the determination of domestic long-term interest rates but a country cannot insulate itself from world interest rates. Thus, domestic interest rates will be above or below the world rate according to its fiscal position, ceteris paribus.

7. Conclusions

This paper has addressed the question of whether high nominal and real long-term interest rates in recent years are associated with large budget deficits. Of particular interest is the issue of crowding-out of private investment resulting from the linkage between budget deficits and long-term interest rates. The answer to this question depends on, first, the reaction of private saving to higher budget deficits and, second, the degree of integration of world capital markets.

The empirical evidence presented here indicates that long-term interest rates increase with larger budget deficits. The regression results show that this relationship is statistically strong and robust during the period from 1970 to 1990. These results are due to the specific methodology used in this paper.

First, the relationship has been examined within a loanable funds model framework. This framework allows the combination of the characteristics of the term-structure with policy variables influencing interest rates. Our point is to show the specific contribution of the budget deficit to the variation of long-term interest rates

on top of monetary policy and other determining factors. Indeed, budget deficits push long-term rates higher than they would otherwise be.

A second important aspect of our approach is the treatment of expectations on future inflation. We used the Hodrick-Prescott filter in order to generate series of expected inflation. This filter has proved to have appropriate mathematical properties to work within a rational expectations framework with sticky prices and slow adjustment, because it takes into account forward and backward looking information on inflation rates.

The third important point is the econometric method we used in order to deal with the problem resulting from the simultaneity between all variables in our model. We used the two-step two stage least squares (2S2SLS) method which allowed us to face this problem within a rational expectations framework. The use of common "world" instrumental variables in all country equations allowed us to make compatible national term structures with the integration of world capital markets.

The strong empirical support for the hypothesis of a positive link between long-term interest rates and budget deficits shows that private savings do not fully compensate for the increase of the budget deficit, therefore Ricardian equivalence, which advocates such a compensation , is not supported by the results.

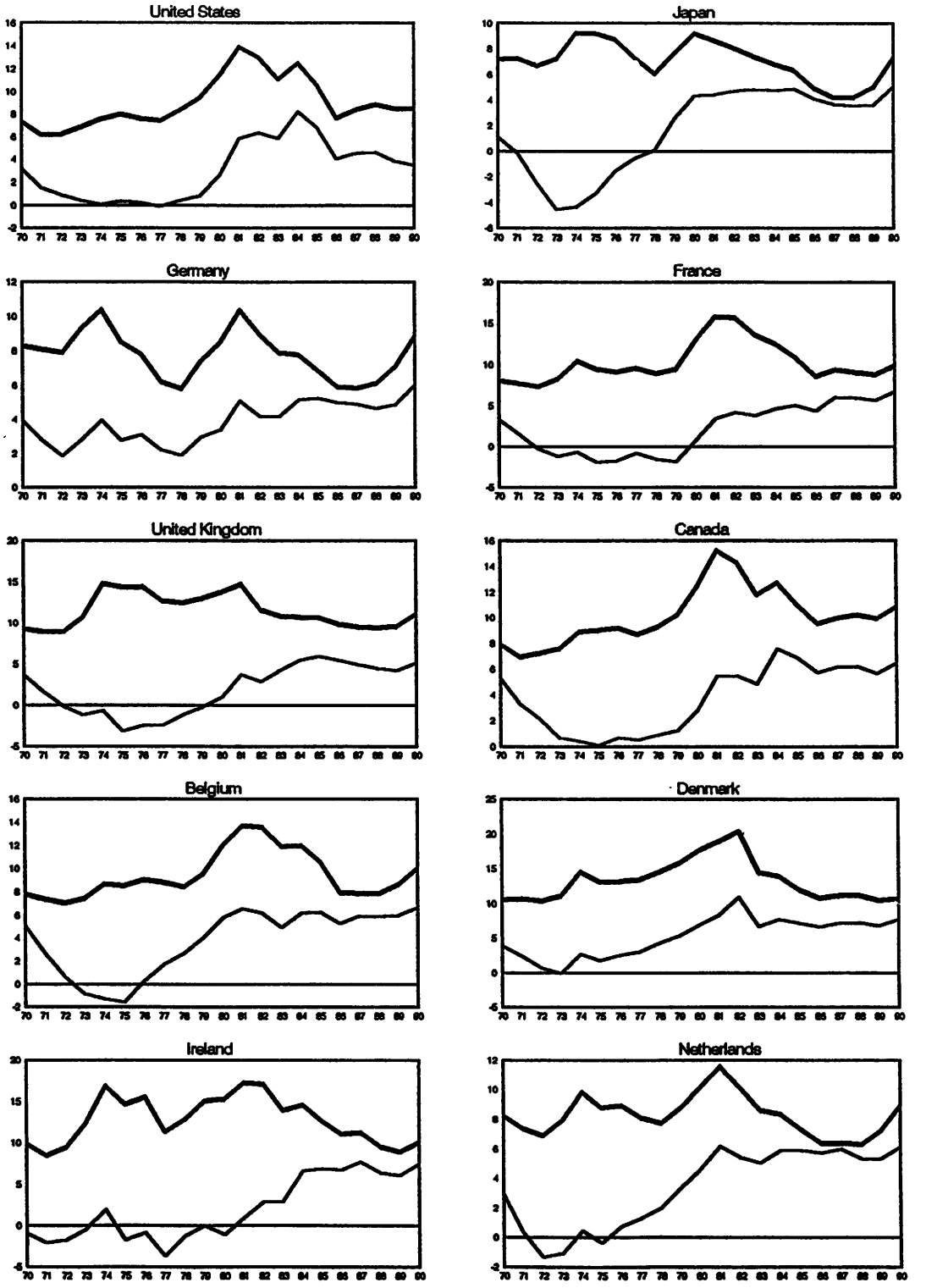
On the other hand, despite growing integration of world capital markets, domestic long-term interest rates are strongly influenced by domestic fiscal policies. The explicit treatment of world capital markets in our model is the focus of our ongoing research in this field.

The relationship between budget deficits and long-term interest rates must be taken into account when devising the appropriate policy mix. A situation of high fiscal deficits limits the degree of freedom for monetary policy to properly manage interest rates.

Chart 1

Long-term interest rates

—Nominal —Real

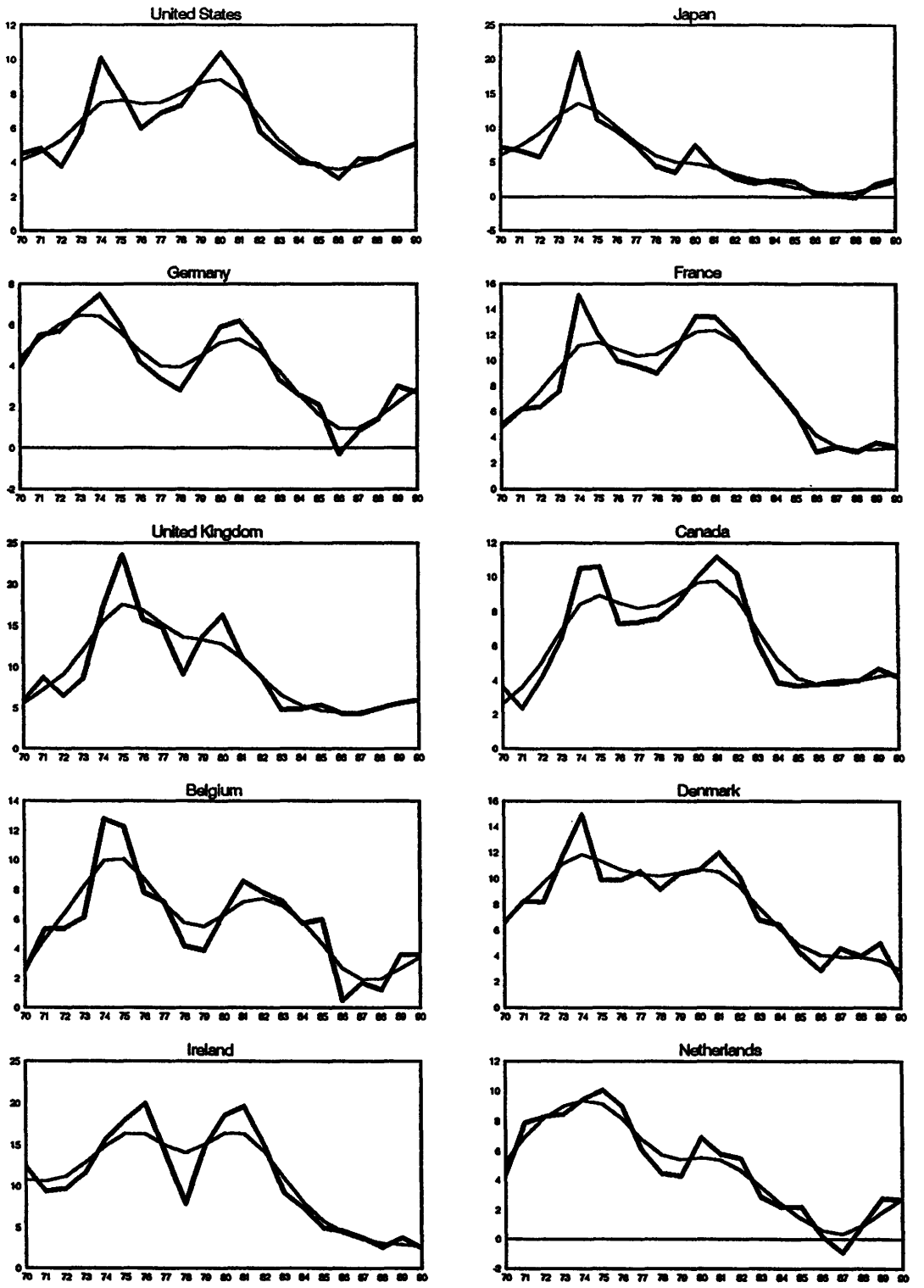


Source: IMF, International Financial Statistics and authors estimates

Chart 2

Inflation rates

— Actual — Trend

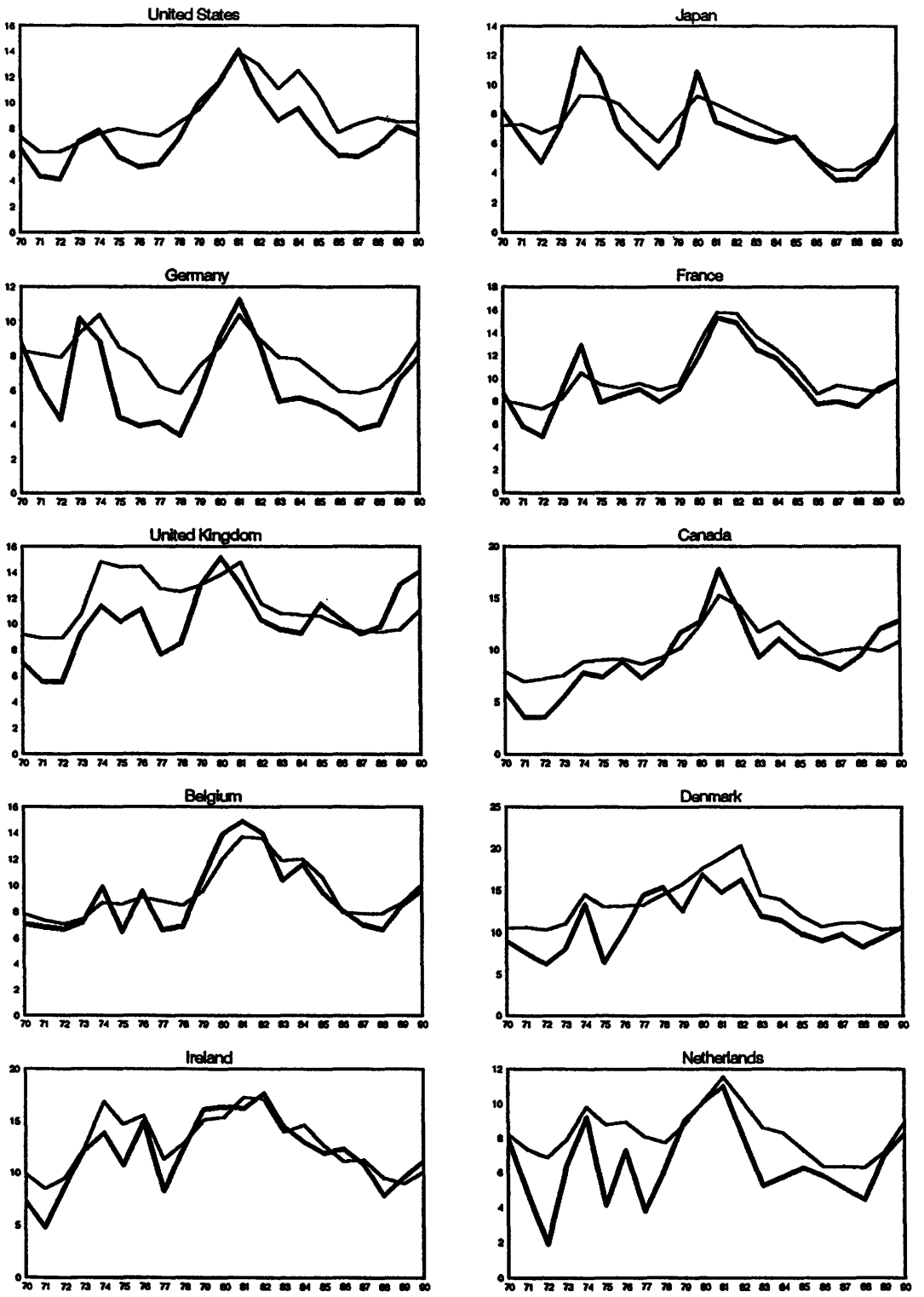


Source: IMF, International Financial Statistics and authors estimates

Chart 3

Short-term and long-term interest rates

Sort-term — Long-term

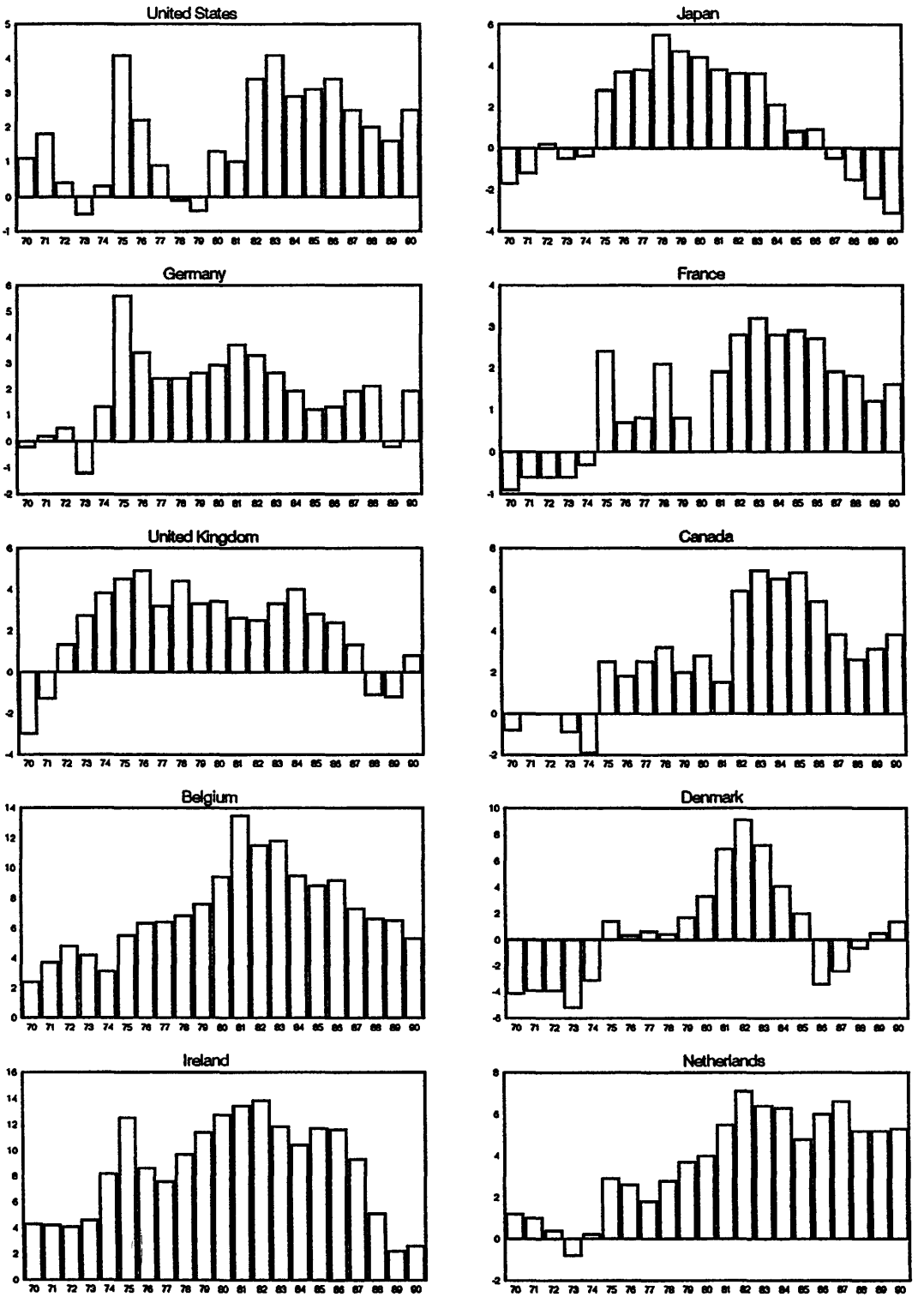


Source: IMF, International Financial Statistics and authors estimates

Chart 4

Budget deficits/GDP ratio

in per cent



Source: IMF, International Financial Statistics and authors estimates

TABLE 1

Long-Term Interest Rate Determinants: Estimation Results , 1970 -1990

	C	ITR	INF	DEF	GDP	R2	DW
UNITED STATES	-0.55	0.96	0.97	0.72	0.3	0.91	2.60
	(-0.76)	*(21.4)*	*(13.1)*	*(8.14)*	*(10.2)*		
JAPAN	1.77	0.66	0.65	0.23	0.12	0.88	1.98
	(2.84)	*(9.78)*	*(13.4)*	*(5.49)*	*(1.68)*		
GERMANY	3.37	0.51	0.68	0.22		0.85	1.10
	(13.3)	*(10.5)*	*(17.0)*	*(3.42)*			
FRANCE	0.25	0.86	0.96	0.52		0.92	1.69
	(0.95)	*(25.5)*	*(29.9)*	*(7.64)*			
UNITED KINGDOM	5.05	0.30	0.56	0.35		0.88	2.09
	(12.7)	*(8.88)*	*(19.4)*	*(6.66)*			
CANADA	0.70	0.61	0.86	0.53		0.87	1.62
	(1.80)	*(15.3)*	*(18.0)*	*(19.6)*			
BELGIUM	2.22	0.38	0.50	0.42		0.89	1.74
	(9.66)	*(7.16)*	*(17.2)*	*(9.20)*			
DENMARK	5.19	0.48	0.76	0.36		0.88	1.52
	(6.70)	*(5.24)*	*(10.48)*	*(4.01)*			
IRELAND	3.51	0.51	0.68	0.17		0.86	1.72
	(5.69)	*(7.23)*	*(10.7)*	*(3.12)*			
NETHERLANDS	1.05	0.44	0.93	0.50		0.89	2.49
	(4.86)	*(22.2)*	*(37.3)*	*(19.9)*			

Notes: 1) t-statistics in parentheses; 2) Two-step two-stage least squares (2S2SLS) regressions

3) ITR=real short-term interest rates, INF=anticipated inflation, DEF=budget deficit/GDP ratio, GDP=GDP annual growth

TABLE 2

Estimated impact of budget deficit on long-term interest rate: 1980-1990

	Budget deficit / GDP Average 1980-1990	**Impact on long-term rate** (basis points)
UNITED STATES	2.53	182
JAPAN	1.06	24
GERMANY	2.05	45
FRANCE	2.07	108
UNITED KINGDOM	1.89	66
CANADA	4.46	236
BELGIUM	9.03	379
DENMARK	2.55	92
IRELAND	9.50	161
NETHERLANDS	5.67	283

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Data Appendix

Data sources: CEC: Commission of the European Community; International Monetary Fund: International Financial Statistics (IFS); OECD: Economic Outlook.

1. General government net borrowing requirement: EC countries are from CEC; United States, Japan and Canada are from OECD.

2. CPI inflation rates: EC countries are from CEC; United States, Japan and Canada are from IFS line 64.

3. Long-term and short-term nominal interest rates are from IFS; Long-term interest rates, line 61; short-term interest rates, line 60b (Japan, Germany, France, Denmark, Ireland, Netherlands) ; short-term interest rates, line 60c (United States, United Kingdom, Canada, Belgium).

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Country Studies*

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